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ABSTRACT

In 1963, the Science Council of Canada recommended that Canada focus its scientific and technological effort on the creation of major programs designed to help solve some of the country's social and economic problems and, specifically, that a space program be initiated. The Canadian decision to become involved in space communication activities was based on domestic, geopolitical, and international considerations. The domestic considerations included a desire for the enhancement of telecommunications facilities in all of Canada, the hope of future economic benefits from the space industry, and the development of national and cultural integration. The geopolitical factors were: the need to enhance regional communications capabilities for the defense of North America, a desire to counter United States mass media infiltration, and the need to occupy radio frequency bands allocated by the International Telecommunications Union before they were taken by the United States. International considerations for the Canadian space program were related to the opportunities for Canadian industries to participate in future international projects. Canadian space contributions have been primarily in the innovative and pragmatic applications of the technology rather than in basic research. (TJ)

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THE POLITICS OF CANADIAN SPACE COMMUNICATION PROGRAMS

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Introduction

In 1966, the federal government established a Crown corporation called the Science Council of Canada. The purpose of this Council was to provide independent assessment of Canada's scientific and technological resources, requirements and potentials, and to make recommendations thereon by publishing reports. The Science Council was concerned with both research and development, and with the application of science and technology to Canada's social and economic problems.[1]

In 1968, the Science Council made several recommendations, including a specific recommendation that Canada focus its scientific and technological effort on the creation of major programs designed to help solve some of the country's social and economic problems. Among these suggested programs, it was recommended that Canada initiate a space program. This recommendation was the result of a report called, A Space Program for Canada. The report called for "the advancement of Canadian capabilities in the science and technology of the upper atmosphere and space; for furthering the development of Canadian industry in relation to the use of the upper atmosphere and space; and for the planning and implementation of an overall space program for Canada."[2]

By this time, as the evidence from the Alouette and ISIS satellite projects suggests, Canadian industry was already heavily involved, and the Canadian space program was much ahead of those in most industrial nations. As a matter of fact, with the launching of Alouette-I, a scientific satellite, in 1962, Canada became a third nation, after the United States and the Soviet Union, to have a satellite in orbit. Since then, Canadian interest in space programs has grown considerably and consistently. Canada successfully experimented with four scientific satellites between 1962 and 1971, and in 1972 it established a new record by becoming the

world's first nation to have a geostationary domestic communication satellite system. (For a brief description of Canada's eight satellites, see Table 1.) Among the factors that seemingly gave momentum to the Canadian space program, it is believed that the political and economic considerations were some of the most crucial ones.

From the very beginning, the Canadian government has been conscious of the politics of space exploration. Since the two superpowers--the United States and the Soviet Union--established duopoly in outer space exploration, several other nations appeared to be interested in following in their footsteps. Although many of these nations wished to develop expertise in outer space exploration, Canada was one of the few that acted on its desire. This raises some interesting questions, however. Why did a nation like Canada need to become an early participant in the space program? What political and economic considerations forced Canada to enter into space communication activities? This paper is aimed at exploring answers to some of these questions.

Motives for Canadian Space Communication Programs

Reflecting on the role of the communication satellite in Canada, a government White Paper on communication satellites declared:

> Canada has an established need for a domestic satellite communication system. The technology of communications makes it possible to solve economically the unique problems created by certain physical and social characteristics of the Canadian territory. It will also meet the special challenge which exists in Canada to improve TV program distribution, throughout the nation, in our two founding languages.[3]

The White Paper concluded that "most arguments in favor of communication satellites are based upon the forseeable evolution of communications, and this "technique is a natural one for the Canadian environment."[4]

Table 1

Canada in Space

Satellites	Launching Dates	Characteristics and Purposes
Alouette-I	Sept. 29, 1962	Launched into a circular orbit--carried four experiments to study the ionosphere--main experiment involved sending radio waves at various frequencies into the ionosphere and measuring their reflection by the layers of charged particles--provided first global information about upper regions of the ionosphere--still sending back useful data.
Alouette-II	Nov. 29, 1965	First of the ISIS series--placed in elliptical orbit--provided new information about behavior of the ionosphere over a range of altitude.
ISIS-I	Jan. 28, 1969	Literally an orbiting laboratory for studying the upper atmosphere--placed in elliptical orbit--provided data for studying radio propagation, radiation, and energetic particles in the upper atmosphere.
ISIS-II	March 31, 1971	Launched into circular orbit--provided additional information about the ionosphere.
Anik-I	Nov. 9, 1972	The first domestic geostationary communications satellite in the world--it provided a high capacity for the East-West television, telephone, and data transmission--now a standby satellite.
Anik-II	April 20, 1973	Launched into synchronous orbit--initially used as back-up for Anik-I--provides Telesat with spare channels some of which have been temporarily leased to American users.
Anik-III	May, 1975	Launched into synchronous orbit--carries 12 high-capacity microwave channels, each of which can relay up to 960 voice signals or a single T.V. program--has recently replaced Anik-I functionally.

Table 1 (continued)

Satellites	Launching Dates	Characteristics and Purposes
Anik-B	1978	To meet communications needs of 1980s, Anik-B will have a seven-year end-of-life performance of 140 watts RF, including full eclipse capacity, compared to Anik-A's 50 watts. It will carry dual-band transponders in the 14/12 and 6/4 GHz bands.

It seems that the Canadian government's initial decision to become enthusiastically involved in space communication activities was based on three primary considerations: domestic ; geopolitical; and international considerations. In the following discussion each of these factors will be explained at length.

Domestic Considerations

Prominent among several domestic considerations in Canada's space communication efforts were the desire for the enhancement of telecommunications facilities to all of Canada; the hope of future economic benefits from the space industry and; national and cultural integration.

Enhancement of domestic telecommunications facilities. The government White Paper especially emphasized the potential use of a Canadian communication satellite for its Northern Territories, along with its application to all developing areas of Canada. It said that the reduced sense of isolation that could be achieved by using communication satellites would be very beneficial in attracting personnel to government and industrial projects in remote areas.

F. G. Nixon, former director of Canadian Telecommunications Policy Bureau, while addressing the same topic, advanced several reasons for the utilization of communication satellites in Canada. Among his major reasons were: geographical vastness and diversity, especially of the Northern Territories; cultural and lingual diversity; entertainment and general information needs; promotion of Canadian character and control in broadcasting; and the improvement of telecommunications structure and the quality of service at a reduced cost. In his view, the attainment of all of these objectives could be facilitated by utilizing communication satellites in Canada.[5]

However, latent in these well-defined statements on the benefits of the communication satellite, was a sense of national glory and pride in national

achievement. The White Paper confirmed this by stating that:

> National identification is intimately associated with technological progress. The power of programmes such as this to attract and hold scientists, engineers, and others, and to cause them to identify their own aims with those of Canada, cannot be ignored.[6]

The early examination of Canada's telecommunications by the Canadian government's White Paper, as well as by several private and public organizations, led to the development and utilization of communication satellites for domestic purposes. An obvious outcome of these efforts has been the creation of a private corporation called Telesat Canada in 1969. The Canadian telecommunications facilities have improved remarkably since the utilization of communication satellites. (See Table 2 for detail.)

In Canada, 96.8 percent of the households are equipped with television (either black and white, or color); 98.3 percent have at least one radio receiver; and telephones are available in about 96.4 percent of the Canadian homes.[7]

Although these figures look impressive, there are distinct regional differences in the availability of telecommunications services. In the South, where most of the Canadians live, telecommunications facilities are taken for granted. In the North, they are scarce. In major metropolitan areas, a tremendous increase in the number of radio stations is causing congestion in the heavily utilized radio frequency bands. However, in the North, where communications are so vital, telecommunications facilities are sparse. This is mainly because of the barriers created by scattered population, immense distances and high cost.

For example, over 99 percent of the population of Ontario has access to television in some form. In New Foundland about 85 percent have television service, but in the Northwest Territories only about 40 percent have coverage.[8]

While a domestic communication satellite system called Anik has significantly improved telecommunications services such as radio, telephone, television, etc., in

Table 2

Number of Households with Television Receiver, Radio Receiver, Telephone and Cable Television in Canada (From 1955 to 1975)

Year	Television (B & W, Color)	Color TV	Radio AM & FM	Radio FM*	Telephone	Cable TV**
1955	1,496,000	NA	3,712,000	NA	2,730,000	NA
1960	3,550,000	NA	4,236,000	NA	3,667,000	NA
1965	4,495,000	NA	4,663,000	1,109,000	4,341,000	NA
1970	5,419,000	686,000	5,489,000	2,989,000	5,304,000	1,164,187
1972	5,850,000	1,478,000	5,961,000	3,814,000	5,777,000	1,689,335
1973	6,017,000	2,081,000	6,124,000	4,213,000	5,955,000	2,115,335
1974	6,257,000	2,892,000	6,374,000	4,652,000	6,222,000	NA
1975	6,488,000	3,581,000	6,588,000	5,074,000	6,463,000	2,703,000

*These figures include combination AM & FM receivers; therefore, subtracting these figures from those in Column 3 would not give the exact number of households with AM receivers.
**Number of subscribers.
Source: Statistics Canada, 1975.

Northern Canada, it is still far from being complete. The Communications Technology Satellite (CTS) project (this is a joint Canada/U.S. project which started in 1976) is expected to demonstrate ways to alleviating the remaining inadequacies in the region.

Canadian telecommunications industry and the space program.

In addition to the consideration for enhancing Canada's telecommunications facilities, there were significant industrial considerations that led Canada's entry into the field of space communications. The White Paper declared that there would be a real advantage for Canadian industry in being amongst the leaders in developing and producing communication satellite equipment. In their view, with the development of foreign competition in this area, the prospect for Canadian industry's entrance into the world market subsequently would diminish. It was their conclusion that the early involvement of Candian industries would improve the position of these firms in their later bids for manufacturing and selling space hardware.[9]

From the very beginning, one of the major aims of the Canadian space program has been to develop skills and production capacity in its industries. Canadian industries participated in the Alouette and ISIS satellite projects; one hope of these programs was that, with the launching of ISIS-II,"a skilled industry should exist in Canada for spacecraft development."[10]

To begin with, RCA Limited and Spar Aerospace Products Limited were involved in the Alouette and ISIS projects. RCA was the prime contractor for Alouette-II and ISIS-I. Their contracts also included works on earth-based facilities in support of the satellites. Spar was the associate contractor with RCA on the Alouette/ISIS projects. A significant achievement in this period was the development of a Storable Tabular Extendible Member (STEM) product at Spar. The STEM

device was used as an extendible antenna system deploying 150 feet from inside a satellite. This device was flown and tested successfully on Canada's Alouette-I satellite in 1962. Since that time, the STEM has been used by many countries including the United States. Until July 1972, over $12 million worth of STEM products were exported by Canada. Also, over the past 12 years, this created an average of 60 jobs for Canadian scientists, engineers, technicians and skilled craftsmen.[11]

The experience gained by these industries has been utilized for Canada's subsequent space programs. For instance, both RCA Canada and Spar industries later participated in Canada's Anik satellite program.(Anik satellites are being used in the Canadian domestic communication satellite system.) RCA constructed 10 earth stations for the Anik system, and Spar became the subcontractor to Hughes Aircraft, which actually built the Anik satellites.[12]

Telesat Canada expects to spend over $400 million during the next decade for building its new generation of communication satellites. Considering the success and expertise of the Canadian space industry, it is expected that most of this money will be spent on domestically produced products.[13]

Cultural and political integration. The last domestic consideration involved in the development of space communication is related to the enhancement of the role of broadcasting, especially television broadcasting in Canada. The contribution of broadcasting to the development of cultural and political integration is now well recognized; this is an especially important consideration in the Canadian situation. In the early 1920's when broadcasting developed in Canada, Sir Henry Thornton, head of the Canadian National Railway, envisaged radio broadcasting as "an instrument for the clear delineation of Canadian indentity."[14]

There were others who foresaw its use as a tool for national integration.

Canada's scattered, culturally and linguistically diverse population has been a challenge for its broadcast media. Some internal political threats, especially the one emerging from the separatist movement in Quebec, quickened the urgency to use communication satellites in Canada. As Hamid Mowlana writes:

> The rising interest in national communications policies in recent years is largely due to the increased struggles. For example, in the recent history of Canada, the dominant arena of social struggle has been the effort to preserve national unity in the face of severe geographical, cultural, and linguistic forces tending toward dis - integration. The fact that the Canadian government has been in the forefront of communications policy research and the development of a satellite communication system can be explained by its perception of the importance of mass communication as a counter to the dis - integrating forces. The prime motivating factor behind these policies has been the need to disseminate Canadian national symbols in order to counter the forces of disintegration.[15]

Besides the domestic considerations involved in the use of communication satellites, there have also been pressing geopolitical demands behind entrance into the field of space communications.

Geopolitical Considerations

Three geopolitical factors can be said to have influenced Canada's desire to enter into space communication programs. These are: the need to enhance regional communications capabilities for the defense of North America; the U.S. mass media infiltration; and the early occupancy of radio frequency bands.

Communications for defense purposes. It seems that early Canada-U.S. cooperation in space was partly motivated by a common goal, i.e., to enhance North American communications for defense purposes. Canada occupies a unique position geographically. The north magnetic pole is located about a thousand miles north of Winnipeg, and much of Canada's northern territory lies within or north of auroral zone. With many people spread thinly throughout this vast, forbidding area, radio

has been the only practical means of communication. Another important consideration is that aircraft flying in this area need reliable radio transmission for navigation and communication.

Atmospheric conditions have a tremendous influence on communications in this region. For example, whenever the ionosphere becomes disturbed, long-range high-frequency radio communication becomes very difficult, if not impossible. The worst ionospheric disturbance in this region, from the communication standpoint, is the "polar blackout." During such disturbances the ionosphere absorbs almost all high-frequency radio waves, making it difficult to communicate between ground stations; transmission is accomplished only by the use of very low - frequency and sophisticated techniques not normally available to commercial users.[16]

In view of the potential transmission disturbances and the serious strategic implications of this region for the defense of Canada and North America, the Canadian Defense Research Board (now Communications Research Center) has been studying the ionosphere for years. Canadian scientists have been interested in studying the ionosphere beyond the region above F-2. (At a height of about 200-300 Km lies the maximum-density F layer. During the daytime in the summer months it can be divided into two layers--F-1 and F-2.) But studying the F-2 region has been more difficult than studying the F-1 region because of lack of powerful instruments and rockets. However, after some suitable rockets became available in the 1950's, Canadian scientists began attempts to study the F-2 region. These early endeavors were complicated by several technical limitations. There were limitations imposed by short flight time, availability of only a few launch sites and the high cost of rocketry. The advent of earth satellites, therefore, provided a powerful mechanism for studying the ionosphere above the F-2 region.[17]

The shared Canada-U.S. goal for such scientific study involving radio

communications actually gave birth to the joint Canada- U.S. satellite project, Alouette-I. It should be mentioned that Canada's close ties with the U.S. through NORAD and NATO facilitated these early cooperative endeavors; in addition, both countries were interested in enhancing communications capabilities for North American defense.

In the two decades following World War II, Canada-U.S. ties were strengthened dramatically in all aspects of national life. The economic and cultural ties between the two nations increased rapidly, and they quickly became important trade partners. However, these relations didn't remain harmonious for any extended period of time. In the 1960's, Canada's perception of these bilateral relations started changing faster than expected. Canadians essentially saw the United States as a threat to their national independence, as well as to their economic and cultural freedom. Voices rose from north of the border about the overwhelming influence of its southern neighbor. Canadians became fearful of living beside and depending upon the world's most powerful nation. Canada's identity was perceived as questionable by some prominent Canadian leaders, especially in light of the increasing U.S. mass media influence on the thoughts and minds of average Canadians.

U.S. mass media infiltration. Canadians have become increasingly sensitive to U.S. mass media penetration into the English-speaking community of Canada, particularly via U.S. television. "Turn on your TV set and chances are two out of three that it will be an American network show on your television screen,"[18] writes a Canadian social critic. As a matter of fact, according to a Senate report, 68 percent of Canadians can receive U.S. television broadcasts and naturally a greater proportion are able to receive radio.[19] According to Peers, in 1970 there were 23 U.S. television stations along the border capable of transmitting signals to Canada.[20] The availability of cable television in these areas has further enhanced U.S. media penetration along the Canada-U.S. border.

In order to reduce U.S. commercials on Canadian cable television, the CRTC, for the first time in 1972, authorized Rogers Cable TV Ltd. of Toronto to delete certain commercial messages from three Buffalo television stations. This decision, upon a challenge by Rogers Cable TV, was upheld by the Canadian Federal Court of Appeal on January 22, 1975.[21] However, more recently the U.S. appears to have won at least temporarily in its television war. The Canadian cabinet has now agreed to an indefinite halt in requiring cable television systems to delete commercials from imported American programs. It is estimated that, if successful, the Canadian regulation could cost U.S. television in the border areas some $20 million annually in advertising revenue.[22]

According to Canadian law, radio and television stations broadcasting from Canada must be owned and operated by Canadians. However, the main concern in Canada is not of direct control but of indirect influence by the U.S. mass media. A great deal of the content of Canadian programs originates in the United States. This has been true in the case of government-owned as well as privately-owned television stations in Canada. For example, the CRTC has charged that the CBC has relied too heavily on popular U.S. television shows to boost its audience ratings.[23]

The indirect U.S. control of the Canadian media has been felt in other ways as well. For example, the Institute of Canadian Advertising, whose member agencies manage between 85 and 90 percent of all advertising in Canada, has 13 U.S.-owned agencies of 49 total (or 26 percent). These companies are, on the whole, larger than their Canadian counterparts since they conduct 36 percent of the business.[24]

Wallace Clement attributes U.S. media infiltration in Canada mostly to the geographical proximity and overwhelming economic power of the United States; he believes that direct ownership of the media is a less important factor. Although a great deal of the content and advertising revenue come from the U.S. or through U.S.-controlled companies, Clement states that the ownership and control of the

media in Canada remains very firmly with the Canadian media elite.[25]

In view of the U.S.-dominated content in Canadian broadcast media, the CRTC several years ago stepped in and required that by October 1971 at least 50 percent of all television and radio programs must have Canadian content; by October 1972, they were to have at least 60 percent. The results of these regulations have been encouraging for Canada. Canadian content in the 1974 English and French schedules exceeded 70 percent, well above the proportion required by CRTC regulations.[26]

The print media in Canada has suffered from the same problems. Most Canadians read U.S. periodicals, and the distribution of these periodicals is largely in the hands of U.S.-owned companies. "In Canada, we may still own the cupboard, but little of the content, " writes Rotstien. He mentions that in Canada, 85 percent of the total magazine circulation and 83 percent of the book sales are foreign. Furthermore, 71 percent of the publishing industry is foreign controlled. In his view "foreign" means mainly American (about four-fifths).[27]

The infiltration of the U.S. mass media in Canada has raised concerns in the minds of many Canadians. This concern entails the issue of "Canadian national identity," as Peers writes. In Peers view, a similar objective of national identity prevails in every country, but it seldom has to be precisely articulated because of natural defenses provided by geography, language differences, or the power of the economy. In Canada, he mentions, "these natural defenses have been lacking, and the American presence is always felt."[28] These concerns have led Canadians to develop their broadcasting facilities at a rapid rate. However, the rapid expansion of broadcasting, especially television broadcasting, created further demands for early occupancy of the radio frequency bands in the North American region by Canada. This will become evident from the following discussion.

Early occupancy of frequency bands. A third geopolitical consideration involved in Canada's entrance into the space program was the perceived need for occupancy of the frequency bands allocated by the International Telecommunications Union (ITU). Since these bands were allocated for all of north America, Canadian planners were afraid that if Canada didn't act quickly, the United States would become an early exploiter of these frequency bands; the U.S. mass media penetration into Canada would therefore be enhanced even further. Reacting to this urgency, the government White Paper wrote:

> . . . The development of communication satellites is proceeding rapidly in Europe and the United States, and these will soon be laying down signals over parts of southern and eastern Canada. Furthermore, there will be early occupation of that synchronous orbit parking space which is of interest to Canada. Unless an early start is made on a Canadian domestic system it may well be overtaken by events. [29]

It should be noted here, that Canada has not only been quick to occupy the synchronous orbit, but has continually attempted to use higher frequency bands for television broadcasting. For example, the CTS project has made Canada the first nation to experiment with 14/12 GHz frequency bands.(This frequency band was allocated by ITU for television broadcasting.) With the proposed launching of Anik-B satellite by Telesat Canada, Canada will become the first nation in the world to use the higher 14/12 GHz frequency band for commercial purposes.

International Considerations

In today's politics, it is frequently difficult to separate a nation's domestic policies from its foreign policies. More simply put, foreign policies for many nations are becoming just an extension of their domestic policies. Therefore, the international considerations involved in Canada's space program may be confused with the domestic considerations.

In any event, the major international considerations for the Canadian space program has been related to the opportunities for Canadian industries to participate in future international projects. But there are some hidden prerequisites for such participation and the obtaining of contracts. Only the industries that have demonstrated a previous capacity to design, construct and manufacture space hardware can compete in today's extremely competitive international space market. The early start of the Canadian government space communication programs gave an impetus to the development of the industry, and gave space-certification to many Canadian industries. The Canadian interest in communication satellites, therefore, evolved from some very early governmental foresight which has allowed Canada to become internationally competetive in the field.

The participation by Canadian industries in international projects such as INTELSAT and other U.S. programs has provided evidence for its breadth. For example, Northern Electronics of Canada has been actively involved in the construction of electronic power conditioners for three INTELSAT IV satellites. Similarly, Spar, as a subcontractor to Hughes Aircraft, has been involved in detail design tasks on the power generation, structure/thermal and attitude control subsystems of advanced communications satellites; Lockhead plans to supplement its work and offer the satellites to INTELSAT and the U.S. domestic communication satellite systems users.[30]

There is other evidence of the Canadian industrial participation in international space programs. In 1975, Canada signed an agreement to join the space shuttle team, and it made a commitment of $30 million for the development of a Remote Manipulator System which would place and retrieve orbital payloads for the space shuttle.[31]

Canada, because of its strenous efforts and continued investment in space communications, is now considered a model for several present and planned communication satellite systems. For instance, in the United States, Western Union's WESTAR and RCA's SATCOM domestic communication systems use satellite control procedure modeled on the Anik satellites. Indonesia's PALAPA system is an another example of this. The specifications for Brazil's satellite communication system call for a satellite control system patterned on Anik satellites,also.[32]

In sum, it appears that Canada is rapidly gaining expertise and international prestige in the space communication field. It can be expected that the Canadian space industry, in the future will stand a better than average chance of success in competition in the international-space-industrial-complex.

Summary and Conclusions

Several important political and economic factors have been involved in Canada's decision to engage vigorously in space communication programs. The most important of all, however, has been the role played by the United States. From the very beginning of the space program, Canada has been dependent on the United States' technological progress. During the early stages of Canada's space program, it relied heavily upon U.S. research for the blueprints of its spacecrafts. Furthermore, Canada has never developed launch capabilities, but has utilized U.S. facilities for these purposes. Current efforts in space-related activities do not provide any clear indications that Canada's technological future will change. This probably will keep Canada-U.S. partnership in space-related activities significant for some time to come.

It seems obvious that Canadian contributions with regard to space communications have not been primarily in the research behind the technologies, but rather in the innovative and pragmatic applications of such technologies. In the beginning of the space race, when much of the emphasis was on launching satellites and gaining scientific knowledge of the upper atmosphere, Canada solicited the United States' help in obtaining such knowledge. Of course such investigations yeilded scientific knowledge, but Canada also gained in other ways from these experiments; by participating in such activities from the very beginning of the space race, it has developed solid technological capabilities in the building of satellites.

However, the priorities given to space exploration by the United States started to decline after the United States' astronauts landed on the Moon. First of all, this was felt in the United States because of public's pressure to reduce space exploration and the subsequent budget cut for NASA by the U.S. Congress. Soon, this trend started to spread to the rest of the world. Taking note of such a turn of events, Canada became one of the few nations to respond to the trend by restructuring its national space policy. No doubt, one factor contributing to a change in Canada's national space policy was related to its continuous efforts to establish a respectable telecommunications industry, thereby maintaining its economic viability. The Canadian government was also very perceptive in realizing that, for a nation such as Canada, its future interest lay in application-oriented space projects. (An example of application-oriented projects would be utilization of communication satellites.) It was their judgment that the future demands for space hardware would be in application-oriented equipment, especially by the third world countries. It appears that this foresight has placed Canada in a prominent position among the space industrial powers.

There may also have been another factor in Canada's change of orientation with regard to space programs. As mentioned earlier, Canada has relied heavily on United States' and has concentrated its efforts on application and development. Since the United States in the 1960's was already actually involved in space research and had already demonstrated an extraordinary capability, it was unlikely that a nation such as Canada could have competed in the world market against giant technological capabilities of the United States. However, NASA's interest in communication satellites soon declined, and it seems that NASA officials were more inclined to experiment cooperatively in space communication rather than going it alone. Also, continuation of space communication projects could have amounted to a significant cost for NASA. Canada was responsive to this, and it seems that both nations have benifitted considerably. They were able to avoid the duplication of efforts in developing communication technologies, and Canada gained recognition for becoming a leader in application-oriented projects in space communication.

It is apparent, then, that Canada's contributions to the application of space communication technology have been extremely relevant. Furthermore, Canada has been responsive to the technological developments that have occurred in the rest of the world, particularly in the United States.

Also, the United States has contributed significantly to Canadian space communication programs. In light of such positive contributions, it seems paradoxical that it was actually perceived threat of U.S. technological and economic strength that propelled Canadian activities in space communication field. We suppose, that's the politics of Canadian space program.

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29. White Paper, op. cit., p. 41.

30. MacNaughton, op. cit., pp. 72-73.

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